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# THE EFFECTS OF SCHOOL LIFE UPON THE HEALTH OF CHILDREN.

BY GEORGE WOODRUFF JOHNSTON, M.D.

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ACCORDING to the report of the Commissioner of Education for the fiscal year ending June 30th, 1903, there were in the United States at that time 22,655,001 children between the ages of five and eighteen, of whom 18,187,918 were enrolled in public or private schools or colleges, or in special institutions of a more or less educational character. Thus, during the period mentioned, more than twenty-two per cent. of our entire people were at school or college, and their education cost for that one year \$251,457,625, or \$3.15 *per capita* of population. To-day, our educational system is even larger, and the expense of maintaining it greater still.

Are these enormous sums spent wisely? Does the institution, private, municipal or State, realize that the most priceless possession of this vast multitude of boys and girls is not learning, but health; and does it so guard them during the most plastic stage of their lives that, when their school-days are over, they may enter the world well, and strong, and properly equipped physically to engage in the struggle for existence, and to become the most effective economic units possible in the community?

We do not know. Investigations touching the health of school children in the United States have been so few, superficial and fruitless that the superintendent of physical training in the Boston public schools was able, at the beginning of the present decade, to state without fear of contradiction that "it is scarcely too much to say that it would be easier under present conditions to estimate the losses entailed by hog-cholera or cattle-plague throughout the Union, than to determine the number of school children who succumb annually to school diseases in the United States." The same may be said now with almost equal truth.

But, by reviewing the examinations made in Europe (where the subject under discussion has received the attention it deserves), and by comparing the results obtained with those to be derived from our own scattered and inconclusive inquiries, we may seek, and perhaps find, answers to our question.

As education became widely disseminated and the standard in all grades of every kind of institution of learning was raised, the demands upon pupils became more and more exacting, until physicians began to note the constant recurrence of a series of morbid phenomena which appeared to be due to the conditions of school life. To determine the precise nature, extent and cause of these phenomena, more or less searching and comprehensive inquiries were undertaken by European investigators—by Hertel in Denmark (1881), by a Danish commission (1882), by a Swedish commission under Axel Key (1883), by a British Parliamentary commission under Crichton-Browne (1884), and by Warner, also in Great Britain (1892)—which inquiries taken together furnish information concerning the health of 104,629 school children, urban and rural, of both sexes, of different ages, and of all social conditions. To these may be added, for each has some feature of interest, the report of Zahor as to the physical condition of 4,892 pupils in the schools of Prague (1888-1890); of Nesterov, 216 pupils in the Moscow schools (1890); of Combe, 3,650 in Lausanne (1892); of Wirenius, 367 in St. Petersburg (1897); of Chalmers and others regarding the health of all the scholars in the Glasgow schools (1904-5), and of a number of special investigations referred to later on.

The methods pursued and the care exercised in these inquiries varied. Some lacked thoroughness; none was, however, wholly slipshod. In many instances, the subjects of scrutiny were examined closely and repeatedly by trained observers, and not only the child and the child's teacher, but certain features of the former's home life, were brought under investigation. In Denmark and Sweden, printed questions as to the pupil's health, the amount of home study, the character and duration of sleep, etc., were given the parents to answer. The information so obtained was submitted first to the family physician and then to the teacher for criticism, correction and amplification, and afterward the child itself was examined, weighed and its eyesight tested. In doubtful cases, the subject was called "well", and ac-

cidental injuries, acute or incidental illnesses, and abnormal conditions attributable to causes lying outside the school were not considered.

All the investigations enumerated, and others not herein specified, disclosed an astonishing amount of ill health among school children; and, though the variations from the norm were found to differ in degree, they were on every hand alike in kind, in nearly every instance more pronounced in girls than boys, and often most manifest in scholars of the better social classes. Thus, there were discovered the following percentages of morbidity ("morbid quality; disease; sickness") among schoolboys—in Great Britain, 20; in Denmark, 29; in Germany, 30; in Copenhagen, 31; and in Sweden, 37: the percentages noted among girls were, in Great Britain, 16; in Copenhagen, 39; in Denmark, 41; in Lausanne, 43; in Germany, 50; and in Stockholm, 62—an average morbidity for boys of 29, and for girls of 42 per cent.

This sum total of ill health was made up of a number of chronic conditions, among which may be mentioned anemia and chlorosis; lack of appetite, indigestion and impaired nutrition; relaxed skin and muscles, and muscular twitching; headache, broken sleep, neuralgia (especially of the intercostal nerves), nervousness, nerve instability, nerve exhaustion, chorea; chest pains, cardiac irritability and palpitation, nosebleed; lateral curvature of the spine, and near-sight, though the latter was not included in many of the percentages above quoted. Further, it was noted that the amount and degree of ill health increased, not with age as years are counted, but rather in direct proportion to the number of work hours, and to the increased burden of studies, as progress was made upward from grade to grade. A greater morbidity of about 6 per cent. was found to exist among pupils who worked more than the average number of hours; and in certain classes and schools, particularly in Stockholm, where the standard was exceptionally high, the average morbidity of neighboring schools was exceeded by from 3 to 10 per cent. The disparity, evident in the statistics of general morbidity above quoted, between countries so nearly alike in all respects as Sweden and Denmark, is explained in the same way—a greater number of working-hours having been required in Sweden at the time these inquiries were made.

The same conditions, doubtless, obtain in this country.

Competent medical men brought to light the fact that special organs and sets of organs, as well as the general health of those attending the high schools of Cleveland, Ohio, suffered in direct ratio to the amount of study in hours; and, in twelve of our best-known colleges for women, there was a gain of 6 per cent. over the average morbidity among those who studied severely.

Thus, it may be said that:

1. At the time these inquiries were undertaken, there was a surprising amount of ill health among school children;

2. Though varying in degree, from slight functional disturbances to actual illness, the same morbid conditions were found wherever and whenever investigations were made; and

3. The percentage of morbidity rose with progress from grade to grade.

In view of these facts, the foregoing affections have been termed "school diseases." They are precisely such morbid states as the conditions of school life—especially fatigue pushed to its pathological extreme—might be expected to induce or aggravate; and, although subjects for control are lacking, inasmuch as the vast majority of children of school age go to school, yet many observers have remarked that the overworked scholar, notably in our higher school grades, is of a weaker fibre and has a less well-balanced nervous system than other members of the same family, of approximately the same age, who stay at home. Indeed, an association of collegiate women, anxious, as we might suppose, to prove the contrary, has demonstrated that, while of 705 girl graduates of America's foremost female and coeducational colleges 19.6 per cent. suffered deterioration of health during their student days, only 16.09 per cent. of 1,032 Boston working-girls of the same age had a like misfortune during the period of their greatest activity. But, after all, comparisons are needless. It is the condition itself, not its relative aspects, that is of the greatest interest and importance.

A critical study of each of the so-called school diseases is unnecessary. But it may be proper to examine a little more narrowly into one of them, to ascertain, for instance, to what extent it is met with the world over, to what degree it is influenced by school life—in brief, to discover if, as one school disease, it illustrates the principles above set down as affecting all.

Headache, whether it be due to anemia, eye strain,\* bad ventilation, fatigue, nerve exhaustion or what not, is, in its origin, distribution and characteristics, the most typical, perhaps, of all school diseases. Grouping information obtained from France, Germany, Great Britain, Sweden, Denmark and Russia, it is apparent that from 40 to 50 per cent. of all school children suffer from this malady; and, further, that it is commonly habitual, usually frontal in location, and that girls are affected more than boys. Moreover, it was noticed that the number of scholars suffering from habitual headache increased (at a maximum rate of 6 per cent. a year) step by step and grade by grade with advancement through school; and, also, that the headache of school-girls began with the term, grew more frequent and intense as it progressed, and disappeared in the holidays, to reappear with the beginning of the next school term. The same effect of alternate work and rest was manifest in the London and Moscow elementary schools, where, in the former, 12 per cent. of the scholars suffered from headache in the morning, 22 per cent. in the afternoon, and in the evening, after a period of rest, only 11 per cent.

Of all the so-called school diseases, however, those affecting the nervous system are of the greatest interest to Americans, and in no other field is the connection between the morbid state, as a result, and school life, as a cause, so clear and intimate, and nowhere else is progressive deterioration so closely related to the demands made upon the scholar.

Wirenius in St. Petersburg, and Nesterov in Moscow, found that 27.5 and 29.25 per cent. of the pupils examined by them, respectively, suffered from disturbances of the nervous system. No distinctive disease marked by typical objective signs was met with by either; but there were headache (constant, or occurring at the end of the day's work), sleeplessness, various neuralgias, neuroses of the heart (palpitation, etc.), rapidly induced mental weariness accompanied by irritability and excitement, and other functional derangements chiefly of a neurasthenic character. Both observers showed also that the disorders named increased in frequency with age and advancement in school grade from a

\* For phases of this subject relating to ophthalmology, gynecology, etc., and not considered here, see article by the late Dr. W. W. Johnston and the author of this paper, "Trans. Med. Soc. D. C.," 1897, II, 61.

minimum of 11 per cent. (Wirenius) and 8 per cent. (Nesterov) at ten years of age, to a maximum of 50 per cent. at eighteen years (Wirenius) and 77 per cent. at nineteen (Nesterov).

In the London schools, 11 per cent. of the children examined showed "abnormal nerve signs"—instability in posture and in balance, loss of tone in the muscles encircling the eyes, finger-twitching, stammering, numerous small movements occurring without apparent stimulation, and muscular eccentricity closely bordering on chorea; while 38 per cent. suffered from sleeplessness, with 6 per cent. of sleep-walkers and nearly 34 per cent. of sleep-talkers. The examiner was told that parents often complained that their children talked of lessons in sleep, arithmetical problems appearing to be the chief disturbing element.

In the higher girls' schools of Germany nervous affections were remarked in fully 70 per cent. of the pupils, and in 20 per cent. sleep was irregular and disturbed.

As to the prevalence of nerve disorders in the school children of the United States, we know little. We have graphic word-pictures of the nerve-sick child and abundant generalizations, but facts are few and sometimes confusing. Twenty-one years ago, an enormous increase in nervous diseases was noted in children of school age in Baltimore, and nine years ago school life was held responsible for 21 out of 150 cases of nerve derangement among Boston pupils treated in a certain hospital. Again, of 417 American college girls showing some form of ill health, 7 per cent. were afflicted with "brain troubles," 33 per cent. with nervousness, and 15 per cent. with neuralgia. One physician in New York, however, found headache and disability of the nervous system less common in grammar-schools, where the average age of scholars is twelve, than in primary schools, where the average age is seven years—the exact opposite of what has invariably been present elsewhere.

How many school children in the United States suffer from or succumb to diseases of the nervous system induced or made worse by school life, and what proportion of such affections encountered in adults originate at this earlier period, it is impossible to say. We know that, wherever careful and comprehensive investigations have been undertaken among school girls and boys, disorders of this system have been found to be numerous and of a character actually or potentially grave. We know

that our heredity, ideals, climate, environment and habits of life predispose to such affections. We know also that the experience of one large general Boston hospital, in which 11 per cent. of 2,000 consecutive admissions were due to neurasthenia (or nervous exhaustion) alone, is not a unique, but on the contrary a common, experience. We know likewise that in the practice of every physician such maladies appear to be gaining in frequency and in severity of type, that insanity is multiplying and our asylums are overcrowded, and, finally, that the ratio of deaths from nervous diseases to deaths from all causes is constantly on the increase. These considerations, reinforced by exact data obtained in Europe, where, after all, conditions are not greatly unlike our own, may well lead us to question the influence of our school establishment upon the children committed to its care.

Many of the investigators previously quoted observed that the number of scholars diminished and the curve of morbidity declined in the highest classes of the schools examined by them. A diminution in the size of classes through the departure of those who left school to enter higher educational institutions or business life would have affected the morbidity percentage, if at all, by increasing it, the strong and successful going out, the sickly and backward remaining behind. This, therefore, cannot account for the descending morbidity curve so often noted. The true explanation lies in the fact that the delicate and ill have fallen out, unable to keep up in the race, and the robust and unyielding have remained behind at school.

This process of selection and elimination has been closely studied in Christiania and in many parts of Germany. It is going on everywhere and in every school grade. In one year more than 10 per cent., and in another nearly 20 per cent., of the public-school children examined by health officers in Boston were thus sent home. In Cleveland, 75 per cent. of the girls and 33 per cent. of the boys who left the high schools during a single year, did so because unable to keep up with their studies by reason of ill health; and in the Waltham, Massachusetts, high school, nine of a class of seventeen left in their graduating year for the same reason. One writer asserts that, in five cities of the United States, sixteen thousand children between eight and fourteen years of age were taken out of the public schools within one school term, because of ill health.



In view of the above facts regarding selection and elimination, it would not appear surprising if the girls and young women in our female and coeducational colleges exhibited a full measure of good health. It has been repeatedly maintained that they do so; and this claim is used as the basis of an argument thought to be convincing and unanswerable, namely: If girl graduates of our school system are well and continue healthy and capable, in spite of the additional tasks they are called upon to perform in college, then there is no overpressure in our schools and nothing wrong with our methods of education. This argument is fallacious. The girls here spoken of are not types of the American schoolgirl; they are the fittest who have survived.

And, again, it has not been satisfactorily proven that the picked college girl is better off physically than the ordinary school-girl. Her burdens rest, proportionately, as heavily upon her as those imposed upon her more plastic and less resistant sister in school, and she bends under them in precisely the same way. Of 705 graduates of twelve of our best-known institutions, including Vassar, Smith, Cornell, etc., 19.6 per cent. lost health during their college days, and 59 per cent. of the whole suffered from some mental or physical disorder after graduation. These figures are striking as compared with the average of 42 per cent. morbidity among girls in the most severely taxed schools in Europe. Further, of these 705 graduates, 26 per cent. married, of whom 37 per cent. were childless at the end of six years of married life. Those who became mothers brought an average of less than two children each into the world, and of these 12 per cent. died at or immediately after birth.

As to the origin of the various forms of ill health prevailing among school children, no one contends that there is but one cause, or that of the many possible or probable causes all lie within the school. Not every child is physically robust when he begins his studies. Before that time and during his whole school life he is influenced by heredity, by home environment, and by a thousand conditions which have nothing to do with the school.

Upon one point, however, the statistics of morbidity previously quoted are distinctly illuminating. No matter what the age, sex, social condition or home life of the pupil; no matter where he may live, nor in what manner of school building he may be housed; no matter how good or bad the heat, light or ventila-

tion, how unsuitable the desks, how high the stairs; no matter if much of the study be done outside of the school proper, one rule always holds good—the percentage of morbidity increases in direct ratio to the amount of study in hours; and, inasmuch as the sum total of ill health is made up of many different units, there is found, wherever intellectual overstrain exists, not only a gain in the number of the fragile and the ill, but also in the variety of morbid states present, and a more pronounced severity in their type. Hence, it is fair to conclude that fatigue is the determining cause of many school diseases, and aggravates most or all of them.

The term “fatigue,” so vague as popularly used, describes a condition whose origin, nature and results have been minutely studied and are not without general interest. The simplest mental process or the slightest bodily movement is impossible without some physical change in the nerve cells that produced or in any way had to do with it, and some destruction of living tissue. The products of such destruction benumb and poison every nerve cell with which they come into contact; and since they are picked up, whirled away and distributed by the circulating blood throughout the entire organism, not only the cells directly concerned and at the immediate site of the described impulse or activity, but all nerve cells within the body, are affected. Thus, while severe mental labor (though the student sit or lie calmly and comfortably), or active exercise of a single muscle or group of muscles (though the remainder of the body be at perfect rest), results in brain fatigue in the one case or fatigue of the special muscle or set of muscles in the other, yet in every instance there inevitably follow weariness and lassitude that are general and felt throughout the entire economy. Provide a period of rest and relaxation, and nature rapidly eliminates these waste products through the proper channels, and exhaustion is followed by refreshment. Keep up the strain, or repeat it with undue frequency, and cells and tissues are continuously poisoned and suffer actual demonstrable changes in their texture and constitution which may never disappear, but, on the contrary, may forever inhibit their activity and effectiveness. Certain birds are so sensitive to fatigue that if, after a day's work in search of food, they are kept awake and in movement throughout the ensuing night, death follows. Children are exceedingly susceptible,

for the reason that none of their tissues has attained full development, strength or stability. Hence, they fare ill if school-work is severe or prolonged, and if periods of rest are infrequent or not of adequate length.

The rapidity with which fatigue shows itself is well illustrated by the experiments of Buergerstein, who gave to a number of school children, in the first hour of the first day's work in a week, a series of equally simple mathematical problems, and who found that the period required for and the difficulties attending their solution (the latter as evidenced by the number of errors undetected by the scholar, or discovered and rectified by him) increased *pari passu* with the flight of time, and reached their maximum in the third quarter of the hour of the experiment.

Conversely, the readiness with which fatigue yields to proper rest or diversion, and the increase in capacity resulting therefrom, are well shown by the fact that, up to a certain point, the shorter the period of study, and the more frequent and prolonged the interval of rest, the greater the quantity and the better the quality of work done. In many cities where limited school-house capacity has made half-day sessions necessary, teachers have been astonished to discover that twice as much work was accomplished as under the old plan, and with far less weariness and worry.

The presence of fatigue can be detected readily by simple objective signs, and its degree can be measured with something like mathematical precision. If we strap (palm upward) one forearm and hand of the pupil to a table-top, fasten to the index-finger a string, running over a pulley, with a weight attached to the other end, and affix to the weight a needle whose point is in contact with a moving drum, we can ascertain and register the amount of local or general fatigue from which the subject suffers. When the pupil rises in the morning, refreshed by a night's sleep, the index-finger by being flexed can raise the weight so many times to such heights in so many minutes, and a certain curve will be registered on the drum. Tire the arm or hand, and the curve changes. Weary the brain by mental labor, exhaust the emotions by anxiety, fear or what not, the arm, hand and entire body remaining at rest, and the index-finger fails in strength and endurance, and the curve shows line by line the existence and degree of fatigue.

Supplement this physiological demonstration by microscopic

examination of the nerve cells of birds or animals which have undergone certain activities, and corresponding nerve cells in kindred (control) birds or animals which have remained at rest, and the existence, and to a certain extent the degree, of fatigue experienced by the former during life will become evident through the changes that have taken place in structure, and the response or lack of response to certain chemical stains. The work of Hodge illustrates these points clearly. He examined nerve cells in the brain and spine of sparrows killed early in the morning and found them sound; while similar cells of other sparrows killed in the evening, after their day's work in quest of food, showed changes in conformation and in reaction to stains. Even birds which had spent a rainy day under tree shelter, and which, having been supplied with food, were called upon for practically no bodily effort, showed pronounced anatomical changes in their cortical brain cells as the result of their mental activities.

It can be readily seen from what has gone before how fatigue dulls the mind and tires the body of the school child, how the nervous system, in its extreme sensitiveness and lack of development and resistance, chiefly suffers, and how the impress of fatigue upon it may become deep and indelible. A nervous system repeatedly jaded by undue fatigue is constantly subjected to a greater and greater tax as the pupil advances from class to class and the burden of work is increased, until perhaps the weight of a hair will decide his fate, and he is either immediately incapacitated for further effort, or enters life with a nervous system so overwrought, unstable and exhausted that, though years may elapse, a single physical or emotional crisis precipitates him into the slough of chronic invalidism.

The remedy for conditions which we know to exist in Europe and which we have every reason to believe are met with in the same or even greater degree in this country, lies not in the almost professional athleticism which is now the vogue; for in this it is evident we are merely substituting for one form of fatigue another no less injurious, but rather in a completer comprehension of the school child as a young animal at work and play, and a rational adaptation of work and play to his capacities and needs. In this way only can he be made fit for the real struggle awaiting him, and become in the community in which his lot is cast a valuable economic unit.

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